

UNCLASSIFIED

AD 270 428

*Reproduced
by the*

**ARMED SERVICES TECHNICAL INFORMATION AGENCY
ARLINGTON HALL STATION
ARLINGTON 12, VIRGINIA**



UNCLASSIFIED

NOTICE: When government or other drawings, specifications or other data are used for any purpose other than in connection with a definitely related government procurement operation, the U. S. Government thereby incurs no responsibility, nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use or sell any patented invention that may in any way be related thereto.

AD 270428




PROPERTIES OF 17-7PH AND PH 15-7Mo STEELS
IN CONDITIONS TH 1050 AND RH 950

31 JULY 1958
(62-2-1)

W. G. Boyd
W. G. Boyd

W. H. McCarthy
W. H. McCarthy

H. D. Childers
H. D. Childers


L. F. Bernbach, General Supervisor
Materials Research Laboratory

[illegible]

ENGINEER Boyd/McCarthy	NORTHROP AIRCRAFT, INC. NORTHROP DIVISION	PAGE 1
CHECKER		REPORT NO. NAI-58-569
DATE 31 July 1958		MODEL

Rev. 23 October 1961

TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
1 Introduction	1
2 Object	1
3 Conclusions	1
4 Test Procedure	2
5 Results	3

Table

I	Chemical Composition and Mechanical Properties Reported by Armco Steel Corporation	5
II	Tensile Properties of 17-7PH Steel, Summary	6
III	Tensile Properties of PH 15-7Mo Steel, Summary	7
IV	Compression Properties of 17-7PH Steel, Summary	10
V	Compression Properties of PH 15-7Mo Steel, Summary	11
VI	Tensile Properties of 17-7PH and PH 15-7Mo Steel after Thermal Exposure, Condition TH 1050	15
VII	Tensile Properties of 17-7PH and PH 15-7Mo Steel after Thermal Exposure, Condition RH 950	17
VIII	Tensile Properties of 17-7PH Steel, Sheet No. 1	21
IX	Tensile Properties of 17-7PH Steel, Sheet No. 2	22
X	Tensile Properties of 17-7PH Steel, Sheet No. 3	23
XI	Tensile Properties of PH 15-7Mo Steel, Sheet No. 4	24
XII	Tensile Properties of PH 15-7Mo Steel, Sheet No. 6	25
XIII	Tensile Properties of PH 15-7Mo Steel, Sheet No. 8	26
XIV	Compression Properties of 17-7PH Steel, Sheet No. 1	27
XV	Compression Properties of 17-7PH Steel, Sheet No. 2	28
XVI	Compression Properties of 17-7PH Steel, Sheet No. 3	29
XVII	Compression Properties of PH 15-7Mo Steel, Sheet No. 4	30
XVIII	Compression Properties of PH 15-7Mo Steel, Sheet No. 6	31
XIX	Compression Properties of PH 15-7Mo Steel, Sheet No. 8	32

Figure

1	Tensile Properties vs. Temperature for Condition TH 1050	8
2	Tensile Properties vs. Temperature for Condition RH 950	9
3	Compressive Yield Strength 90.2% Offset) vs. Temperature	12
4	Tensile Elastic Modulus vs. Temperature	13
5	Compressive Elastic Modulus and Ramberg-Osgood Stress-Strain Shape Parameter vs. Temperature	14
6	Tensile Properties after 100 Hours Thermal Exposure	19
7	Tensile Properties after 500 Hours Thermal Exposure	20

ENGINEER Boyd/McCarthy	NORTHROP AIRCRAFT, INC. NORTHROP DIVISION	PAGE 1
CHECKER		REPORT NO. NAI-58-569
DATE 31 July 1958		MODEL

1. INTRODUCTION

17-7PH steel in condition TH 1050 is currently the most attractive precipitation-hardenable sheet steel for use in aircraft structure. This is due to good fabricability, reliability, and uniformity, as well as to the high strength obtainable. PH 15-7Mo is a recent modification of 17-7PH which contains molybdenum and is designed to extend the useful temperature range of 17-7PH by 100F° to 200F°. It has been reported that the properties of these materials can be substantially improved by using refrigeration heat treatment, condition RH 950, with a proportional decrease in airframe weight. The work described in this report was undertaken to verify the reported increases in properties, provide data for the establishment of design allowables, and determine the extent of embrittlement caused by long exposure in the 700F to 900F temperature range.

2. OBJECT

To determine short-time tensile and compressive properties of 17-7PH and PH 15-7Mo steels, conditions TH 1050 and RH 950, at room temperature, 600F, 800F, 900F, and 1000F; and to determine the effect of long exposure at 700F, 800F, and 900F upon room-temperature tensile properties.

3. CONCLUSIONS

- 3.1 The test results obtained for both 17-7PH and PH 15-7Mo during this program indicate that the RH 950 treatment produces substantially stronger material (by more than 10,000 psi) than does the conventional TH 1050 treatment. This improvement persists at elevated temperatures to about 800F. At the 900F testing temperature, condition RH 950 material is about equal to TH 1050 steel; but at 1000F, TH 1050 is slightly superior.
- 3.2 The data show that PH 15-7Mo is substantially stronger than 17-7PH, especially at the higher test temperatures. The improvement at 1000F is about 15,000 psi for condition TH 1050 and about 25,000 psi for condition RH 950.
- 3.3 Elevated-temperature compressive yield strength of both steels was found to be roughly equivalent to tensile yield strength, although anomalous effects were observed.
- 3.4 The thermal stability of 17-7PH and PH 15-7Mo steels was found to be better than was initially supposed. Except for 17-7PH in condition RH 950, all materials had average tensile elongation in excess of 4.5% after exposure at 700F, 800F, or 900F for 100 and 500 hours. The most severely embrittling exposure temperature was found to be 800F. 17-7PH in condition RH 950 was almost completely embrittled (0.3% elongation) after 500 hours at 800F, and it had only about 3% elongation after 100 hours at this temperature.

ENGINEER Boyd/McCarthy	NORTHROP CORPORATION NORAIR DIVISION	PAGE 2
CHECKER		REPORT NO. NAI-58-569
DATE 31 July 1958 Rev. 23 October 1961		MODEL

4. TEST PROCEDURE

4.1 Materials - Three sheets of 17-7PH and three sheets of PH 15-7Mo steel were procured from Armco Steel Corporation for the present work. Each sheet, nominally 0.040 inch thick by 36 inches wide and 120 inches long, was taken from a separate production heat. The 17-7PH material conforms to MIL-S-25043 and the PH 15-7Mo meets the manufacturer's guaranteed properties, as attested to by the mill reports shipped with the material. Table I gives the physical and chemical data supplied by Armco Steel Corporation for each sheet. All sheets were received in the annealed condition with a number 2D finish. The sheets are the same as those used for the heat treatment study reported in NAI-58-619. Mechanical properties of the test material in the hardened condition were verified by the testing reported herein and in NAI-58-619.

4.2 Heat Treatment - The heat treatment processes specified for the 17-7PH and PH 15-7Mo material used in this program were as follows:

Condition TH 1050 - Heat to 1400F for 90 minutes; air cool to 50F to 60F, hold 30 to 60 minutes; heat to 1050F for 90 minutes, air cool.

Condition RH 950 - Heat to 1750F for 10 minutes, air cool; liquid cool to -100F to -110F for 8 hours; heat to 950F for 60 minutes, air cool.

The 1400F and 1750F annealing temperatures were held to within a $\pm 5F$ tolerance, and the 950F and 1050F aging temperatures were held to $\pm 2F$. Commercial tolerances are $\pm 25F$ and $\pm 10F$, respectively. All high-temperature treatments were performed in air. The subzero treatment was performed in a mixture of dry ice and isopropyl alcohol. Specimens were mechanically descaled after heat treatment so that deleterious effects of acid pickling were avoided.

4.3 Testing

4.3.1 Test temperatures used were room temperature (72F), 600F, 800F, and 1000F. The following properties were obtained at each test temperature: tensile and compressive yield strength (0.2% off-set), tensile ultimate strength and ultimate elongation in 2 inches, Young's modulus in tension and in compression, and the Ramberg-Osgood compressive stress-strain shape parameter, 'n'. (Descriptions of the 'n' parameter, together with the method of calculation, are given in NACA Tech note 902, July 1943.) The elevated testing temperatures were held to within $\pm 5F$, and soaking time before testing was 30 minutes ± 5 . Cycling of specimens was used so that a specimen was tested every 10 minutes. All the above tests were conducted in triplicate for each sheet. Room-temperature tensile data were also determined on specimens exposed at 700F, 800F, and 900F for 100 to 500 hours. One specimen from each sheet was tested for each exposure condition.

ENGINEER Boyd/McCarthy	NORTHROP CORPORATION NORAIR DIVISION	PAGE 3
CHECKER		REPORT NO. NAI-58-569
DATE 31 July 1958 Re. 23 October 1961		MODEL

4.3.2 Testing was performed according to requirements set forth in Federal Test Method Standard No. 151, using standard Northrop procedures on a Baldwin-Lima-Hamilton 10,000 pound capacity testing machine, and a Pacific Scientific elevated temperature test chamber. Test equipment and fixtures are described and illustrated in report NAI-57-246. Standard tensile specimens 8 inches long with a uniform 2 inch long reduced section were pulled by means of a pin inserted through a 1/2 inch hole in the grip section. Standard 1 inch by 3 inch compression coupons were tested in an NAA-type compression test fixture. Horizontal steel leaves 1/16 by 7/8 by 3 inches, under screw-applied pressure, supported the specimen in a vertical position. After the specimen was loaded in the compression fixture, a compressor was attached, recording strain produced in the central 2 inch section of the specimen when load was applied. The strain rate for all tests was maintained between 0.003 and 0.007 inch per inch per minute until yield loading was achieved. Autographically recorded load-strain curves were used for determination of yield strengths, elastic moduli, and 'n' parameters.

5. RESULTS

5.1 Room and Elevated Temperature Tensile and Compression Properties

5.1.1 Tensile properties for three sheets of 17-7PH steel in conditions TH 1050 and RH 950 are summarized in Table II; equivalent data for PH 15-7Mo steel are given in Table III. The values entered in Tables II and III for each sheet of steel are the averages of the data from three tests. The tensile data for individual specimens are presented in Tables VIII through XII. Compression properties for each sheet and each condition appear in Table IV for 17-7PH and in Table V for PH 15-7Mo. Individual test results for compression specimens are given in Tables XIV through XIX.

5.1.2 The tensile properties (with the exception of elastic modulus) are presented graphically as functions of testing temperature in Figure 1 for 17-7PH and PH 15-7Mo in condition TH 1050; Figure 2 gives the equivalent information for condition RH 950. Compressive yield strength versus temperature for each material and condition is plotted in Figure 3. Note that the large differences between the PH 15-7Mo sheets in condition TH 1050 necessitated separate curves for each sheet instead of a mean curve representing all three sheets. Tensile modulus of elasticity is given graphically in Figure 4; compressive modulus and compressive 'n' parameter are presented in Figure 5. The modulus and 'n' values are considered approximate, since thermal expansion of linkage and remoteness of the microformer strain-measuring device limits the precision with which stress-strain curves can be obtained.

ENGINEER Boyd/McCarthy	NORTHROP CORPORATION NORAIR DIVISION	PAGE 4
CHECKER		REPORT NO. NAI-58-569
DATE 31 July 1958 Rev. 23 October 1961		MODEL

- 5.2 Room Temperature Tensile Properties after Elevated Temperature Exposure - Tensile properties after 100 hours and after 500 hours exposure at 700F, 800F, and 900F are presented in Table VI for both steels in condition TH 1050. Similar information for condition RH 950 is given in Table VII. The tensile data for 100 hours exposure are presented as functions of exposure temperature in Figure 6. Similar curves, showing the embrittlement produced by 500 hours exposure, appear in Figure 7.

DATE 31 July 1958

Rev. 23 October 1961

TABLE I. CHEMICAL COMPOSITION AND MECHANICAL PROPERTIES
REPORTED BY ARISCO STEEL CORPORATION

Alloy Sheet Number Heat Number Specification	17-7PH			PH 15-7Mo		
	1	2	3	4	6	8
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	66880	57814	57896	57798
PH 15-7Mo	57391	66922	6			

ENGINEER Boyd/McCarthy	NORTHROP AIRCRAFT, INC. NORTHROP DIVISION	PAGE 6
CHECKER		REPORT NO. NAI-58-569
DATE 31 July 1958 Rev. 23 October 1961		MODEL

TABLE II. TENSILE PROPERTIES OF 17-7PH STEEL
SUMMARY OF THREE SHEETS

Test Temp	Sheet No.	Condition TH 1050				Condition RH 950			
		Fty* ksi	Ftu* ksi	Elong.* % in 2 in.	E*** psi x 10 ⁶	Fty** ksi	Ftu** ksi	Elong.** % in 2 in.	E*** psi x 10 ⁶
Room	1	170.9	182.4	7.8	26.1	212.9	224.8	8.3	27.7
	2	165.1	177.8	10.7	26.2	210.4	222.8	10.3	27.2
	3	172.5	185.7	9.2	26.1	213.1	228.2	9.8	27.7
	Avg.	169.5	182.0	9.2	26.1	212.1	225.3	9.5	27.5
600F	1	161.4	171.5	4.3	25.9	172.0	188.1	7.2	26.4
	2	155.3	165.1	5.2	24.9	175.5	191.3	4.8	26.1
	3	164.8	174.0	4.7	24.8	177.6	194.6	6.3	27.5
	Avg.	160.5	170.2	4.7	25.2	175.0	191.3	6.1	26.7
800F	1	139.9	150.2	9.8	24.6	141.7	164.6	15.8	25.5
	2	134.0	145.3	12.0	23.2	144.8	167.9	12.5	22.4
	3	141.3	153.5	12.7	24.8	148.0	166.2	13.1	23.3
	Avg.	138.4	149.7	11.5	24.2	144.8	166.2	13.8	23.7
900F	1	116.2	129.0	16.7	24.1	121.0	143.9	16.5	23.2
	2	112.8	125.7	16.2	23.9	122.3	143.3	14.5	22.1
	3	114.2	128.5	18.5	22.5	125.2	143.7	14.8	21.5
	Avg.	114.4	127.7	17.1	23.5	122.8	143.6	15.3	22.3
1000F	1	82.8	99.2	31.7	20.5	79.7	100.4	29.8	21.3
	2	78.6	96.3	29.8	20.6	75.1	99.5	27.5	23.0
	3	80.6	97.2	31.2	19.6	75.7	97.4	31.3	20.8
	Avg.	80.7	97.6	30.9	20.2	76.8	99.1	29.5	21.7

* Plotted on Figure 1
** Plotted on Figure 2
*** Plotted on Figure 4

ENGINEER

Boyd/McCarthy
CHECKERNORTHROP AIRCRAFT, INC.
NORTHROP DIVISION

PAGE

7

REPORT NO.

NAI-58-569

DATE 31 July 1958

MODEL

Rev. 23 October 1961

TABLE III. TENSILE PROPERTIES OF PH 15-7Mo Steel
SUMMARY OF THREE SHEETS

Test Temp	Sheet No.	Condition TH 1050				Condition RH 950			
		Fty* ksi	Ftu* ksi	Elong.* % in 2 in.	E *** psi x 10 ⁶	Fty ** ksi	Ftu ** ksi	Elong.** % in 2 in.	E *** psi x 10 ⁶
Room	4	180.1	185.0	7.8	25.8	199.8	217.9	8.8	26.4
	6	175.7	187.3	10.0	25.0	205.7	223.3	9.2	26.0
	8	174.7	191.6	10.5	26.2	208.6	227.8	9.0	25.5
	Avg	176.8	188.0	9.4	25.7	204.7	223.0	9.0	26.0
600F	4	165.5	177.4	4.1	26.2	170.4	198.5	4.7	27.5
	6	161.7	175.2	4.1	26.1	178.3	205.0	5.3	27.6
	8	163.6	180.6	4.8	26.3	180.7	210.1	4.7	27.5
	Avg	163.6	177.7	4.3	26.2	176.5	204.5	4.9	27.5
800F	4	148.3	161.8	9.9	25.3	147.7	178.0	9.5	25.0
	6	142.5	158.2	8.8	24.3	152.3	181.7	11.3	24.7
	8	145.1	164.0	9.8	23.7	150.5	185.0	8.8	25.9
	Avg	145.3	161.3	9.5	24.4	150.2	181.6	9.9	25.2
900F	4	126.5	141.4	15.2	24.3	127.4	160.1	11.5	23.0
	6	125.1	142.6	12.0	26.0	129.4	162.0	12.0	23.8
	8	126.4	145.6	12.0	23.7	132.4	168.2	10.7	23.4
	Avg	126.0	143.2	13.1	24.7	129.7	163.4	11.4	23.4
1000F	4	98.0	114.6	19.0	21.7	98.7	130.7	15.2	22.0
	6	96.8	114.0	19.2	22.1	99.6	130.3	15.2	20.6
	8	98.3	120.1	19.0	22.5	104.2	136.9	13.1	22.9
	Avg	97.7	116.2	19.1	22.1	100.8	132.6	14.5	21.8

* Plotted on Figure 1

** Plotted on Figure 2

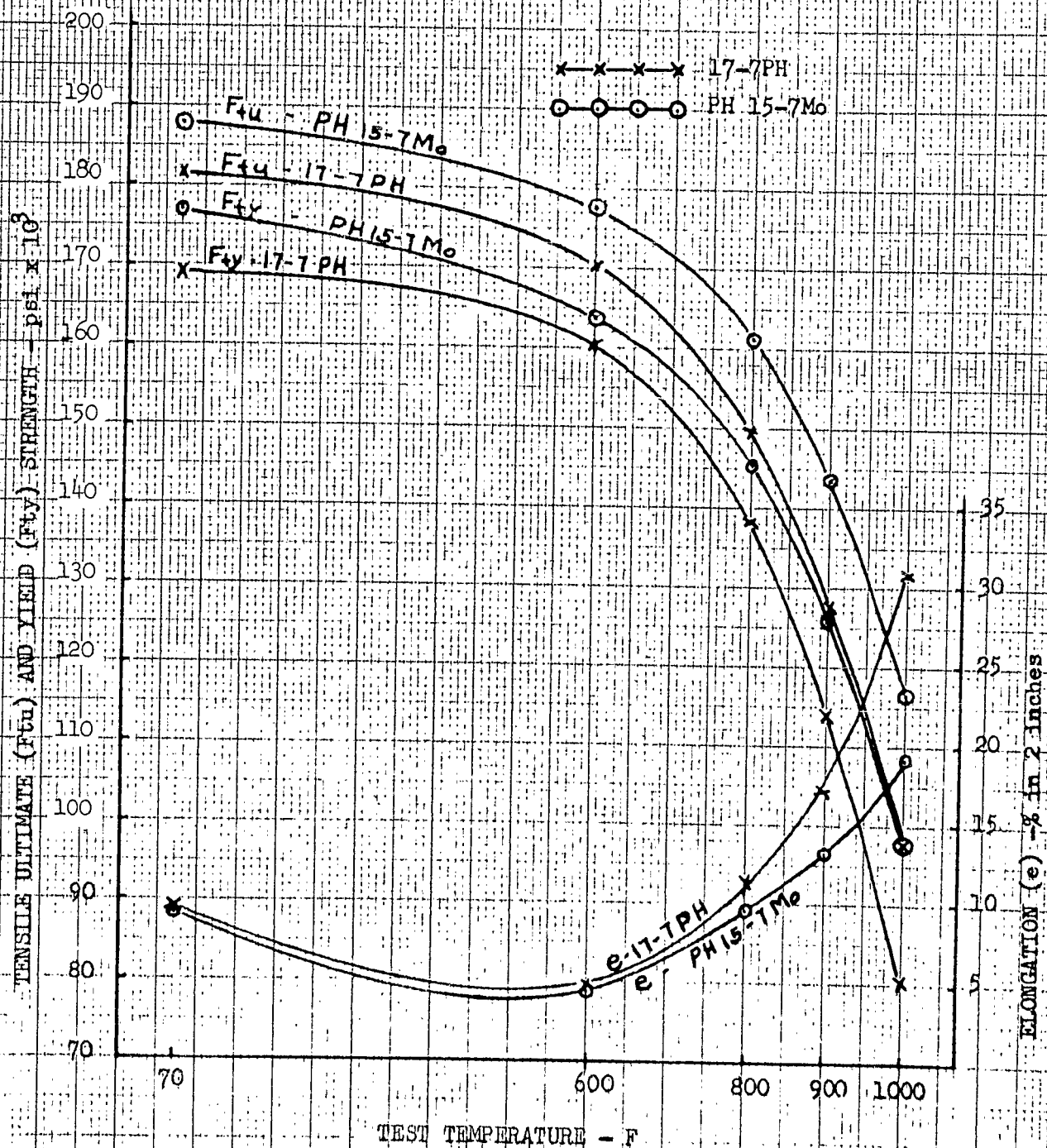
*** Plotted on Figure 4

ENGINEER Boyd/McCarthy	NORTHROP AIRCRAFT INC. NORTHROP DIVISION	PAGE 8
CHECKER		REPORT NO. NAI-58-569
DATE 31 July 1958		MODEL

Rev. 23 October 1961

FIGURE 1.

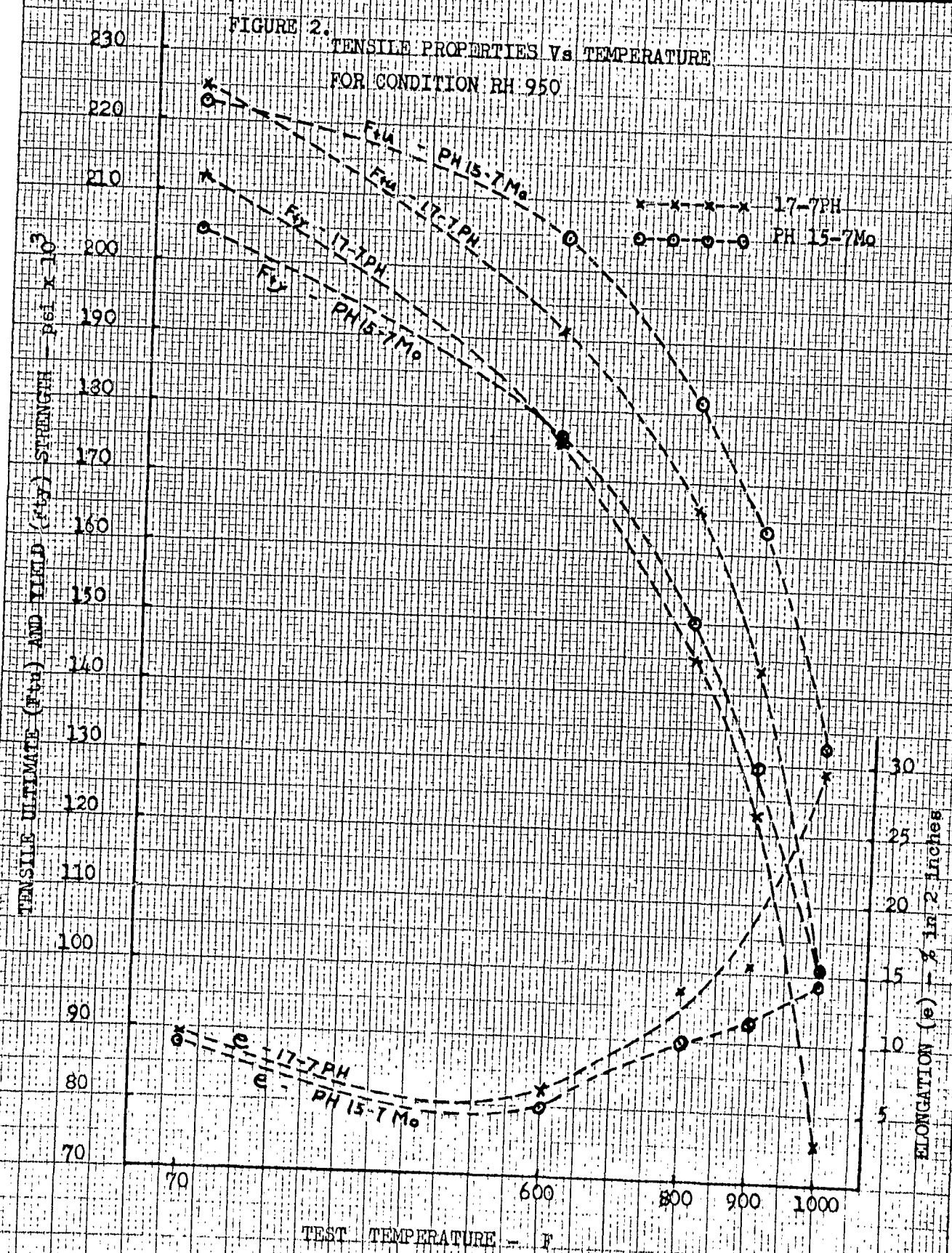
TENSILE PROPERTIES Vs. TEMPERATURE
FOR CONDITION TH 1050



ENGINEER Boyd/McCarthy	NORTHROP AIRCRAFT INC. NORTHROP DIVISION	PAGE 9
CHECKER		REPORT NO. NAI-58-569
DATE 31 July 1958		MODEL

Rev. 23 October 1961

FIGURE 2.
TENSILE PROPERTIES Vs TEMPERATURE
FOR CONDITION RH 950



ENGINEER Boyd/McCarthy	NORTHROP AIRCRAFT, INC. NORTHROP DIVISION	PAGE 10
CHECKER		REPORT NO. NAI-58-569
DATE 31 July 1958 Rev. 23 October 1961		MODEL

TABLE IV. COMPRESSION PROPERTIES OF 17-7PH STEEL
SUMMARY OF THREE SHEETS

Test Temp	Sheet No.	Condition TH 1050			Condition RH 950		
		Fcy* ksi	E ** psi x 10 ⁶	'n' **	Fcy* ksi	E ** psi x 10 ⁶	'n' **
Room	1	198.6	31.3	26.1	237.0	31.8	24.8
	2	200.8	31.2	26.8	239.4	32.9	31.0
	3	205.8	31.9	20.3	244.5	31.3	17.5
	AVG	201.7	31.5	24.2	240.3	32.0	23.1
600F	1	166.5	26.3	14.3	184.2	29.1	14.7
	2	166.4	26.5	12.8	182.9	27.5	32.0
	3	171.0	29.7	10.3	188.6	28.7	10.9
	AVG	168.0	27.5	12.3	185.2	28.4	15.5
800F	1	137.1	24.0	11.3	161.4	27.0	12.5
	2	140.9	24.4	13.9	167.3	28.1	13.0
	3	146.8	24.8	18.2	168.6	27.7	23.1
	AVG	141.6	24.4	13.9	165.8	27.6	14.9
900F	1	114.1	24.4	12.7	135.9	24.8	10.6
	2	113.7	22.4	17.6	136.1	24.5	10.4
	3	110.5	24.6	9.1	139.6	25.7	14.9
	AVG	112.8	23.8	12.1	137.2	25.0	11.5
1000F	1	95.5	19.0	15.8	85.2	18.0	8.3
	2	93.3	18.5	12.4	88.6	19.2	11.1
	3	99.2	19.6	14.1	86.3	17.0	11.1
	AVG	96.0	19.0	13.9	86.7	18.1	10.0

* Plotted on Figure 3

** Plotted on Figure 5

ENGINEER Boyd/McCarthy	NORTHROP AIRCRAFT, INC. NORTHROP DIVISION	PAGE 11
CHECKER		REPORT NO. NAI-58-569
DATE 31 July 1958 Rev. 23 October 1961		MODEL

TABLE V. COMPRESSION PROPERTIES OF PH 15-7Mo STEEL
SUMMARY OF THREE SHEETS

Test Temp	Sheet No.	Condition TH 1050			Condition RH 950		
		Fcy ksi*	E *** psi x 10 ⁶	'n' ***	Fcy ksi **	E *** psi x 10 ⁶	'n' ***
Room	4	201.3	30.9	20.3	237.7	32.0	26.1
	6	178.8	32.1	15.5	239.1	33.8	24.2
	8	143.5	29.3	7.6	249.6	31.3	22.1
	Avg	174.5	30.8	11.9	242.1	32.4	23.6
600F	4	171.8	27.2	9.0	192.6	27.9	11.1
	6	157.2	23.4	12.3	196.1	27.5	11.6
	8	125.4	21.9	5.7	200.2	27.2	10.9
	Avg	151.5	24.2	8.0	196.3	27.5	10.8
800F	4	148.2	22.8	14.1	169.3	28.4	13.6
	6	140.7	23.2	12.8	170.9	27.6	17.6
	8	123.4	21.9	6.1	180.9	28.6	14.3
	Avg	137.4	22.6	9.4	173.7	28.2	14.9
900F	4	125.2	24.0	10.6	143.9	24.8	10.4
	6	123.9	21.2	12.7	148.9	26.1	12.5
	8	114.7	20.3	8.9	139.1	25.7	8.2
	Avg	121.3	21.8	10.4	144.0	25.6	10.1
1000F	4	109.3	20.8	13.9	116.2	21.6	7.6
	6	108.4	20.2	10.6	113.4	21.4	7.0
	8	103.8	18.9	11.4	120.6	23.0	7.5
	Avg	107.2	19.9	11.8	116.7	22.0	7.4

* Individual values plotted on Figure 3

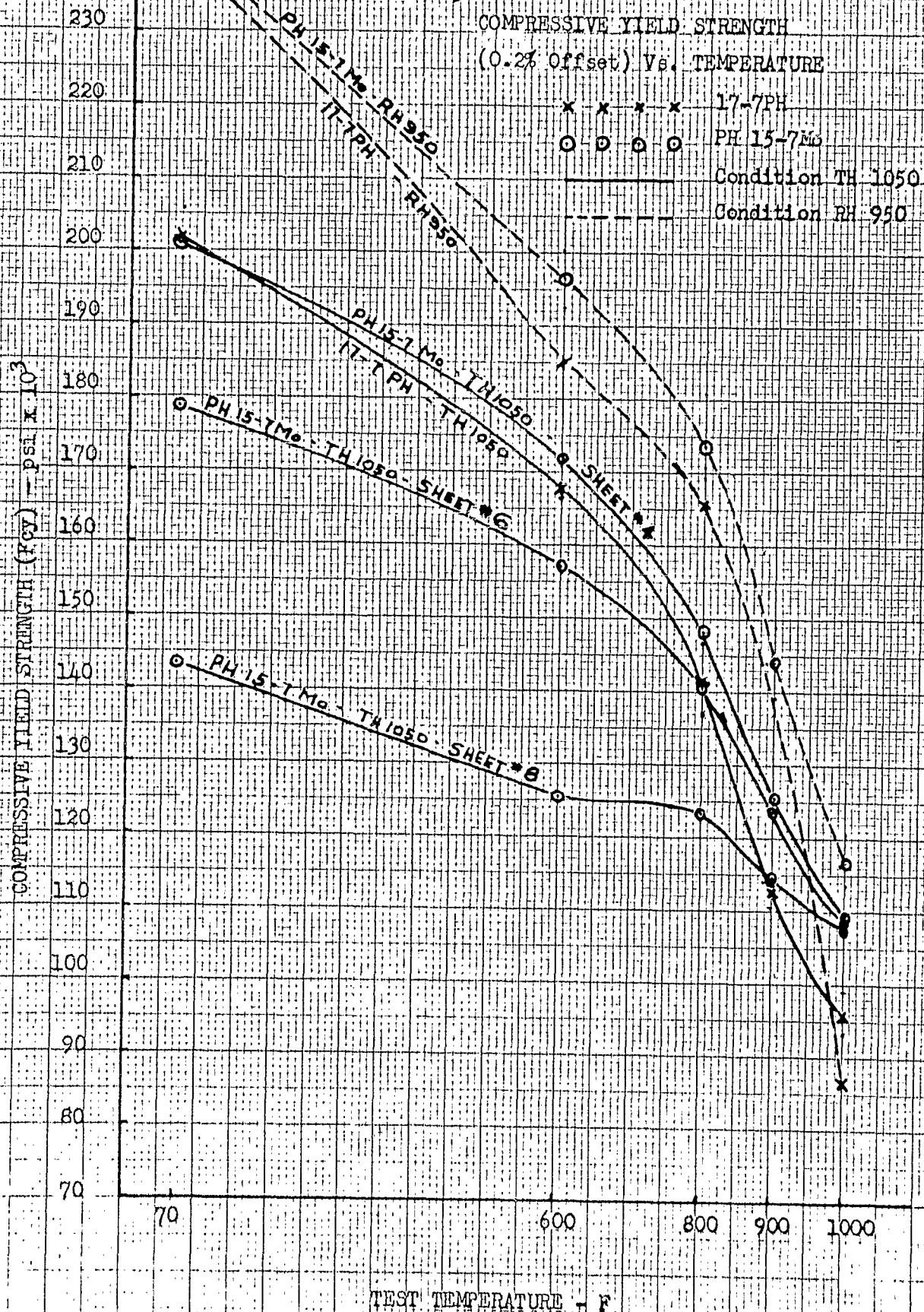
** Averages plotted on Figure 3

*** Averages plotted on Figure 5

ENGINEER Boyd/McCarthy	NORTHROP AIRCRAFT INC. NORTHROP DIVISION	PAGE 12
CHECKER		REPORT NO. NAT-58-569
DATE 31 July 1958 Rev. 10-23-61		MODEL

FIGURE 3.

COMPRESSIVE YIELD STRENGTH
(0.2% Offset) Vs. TEMPERATURE

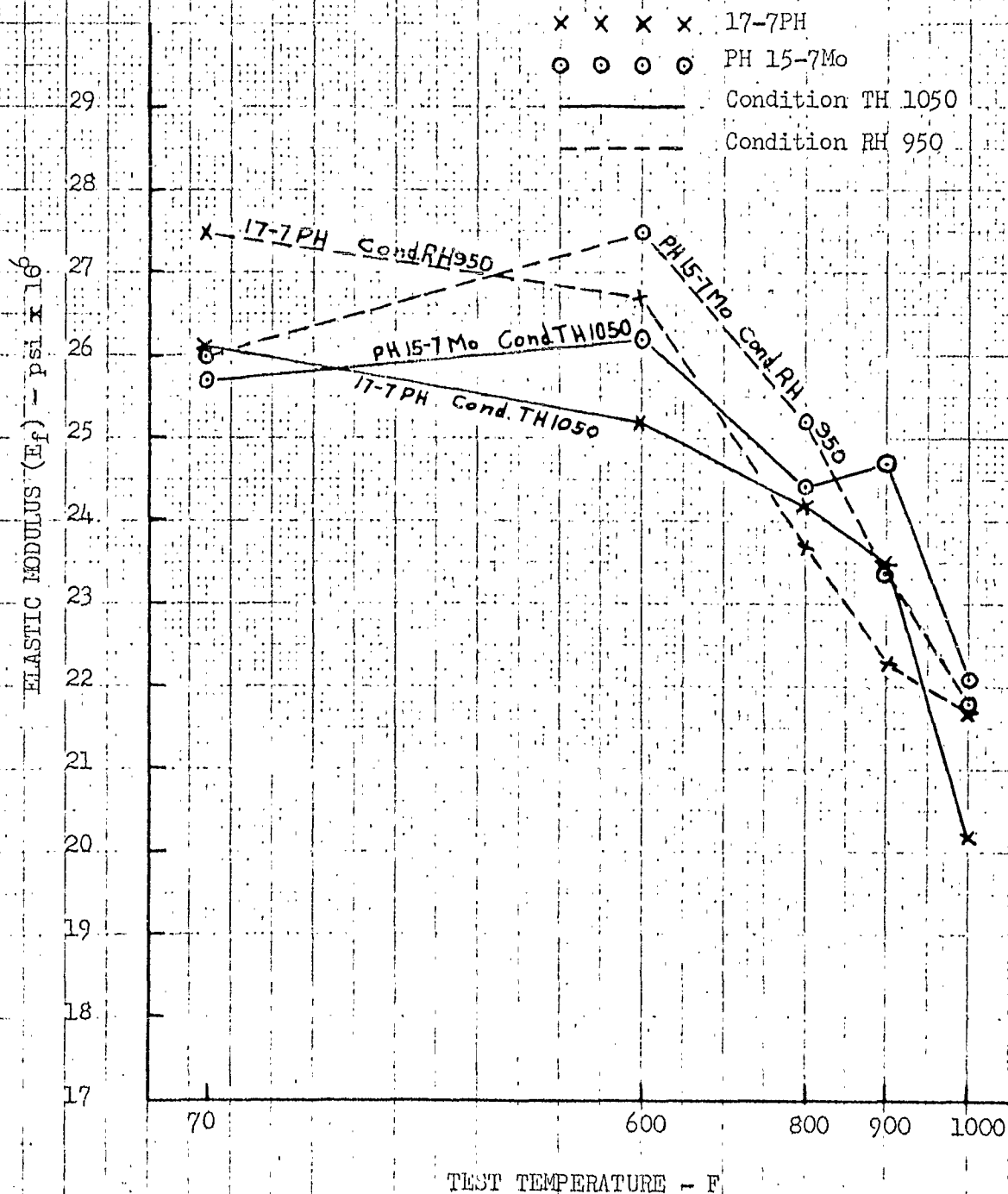


ENGINEER Boyd/McCarthy	NORTHROP AIRCRAFT INC. NORTHROP DIVISION	PAGE 13
CHECKER		REPORT NO. NAI-58-569
DATE 31 July 1958		MODEL

Rev. 23 October 1961

FIGURE 4.

TENSILE ELASTIC MODULUS
Vs. TEMPERATURE

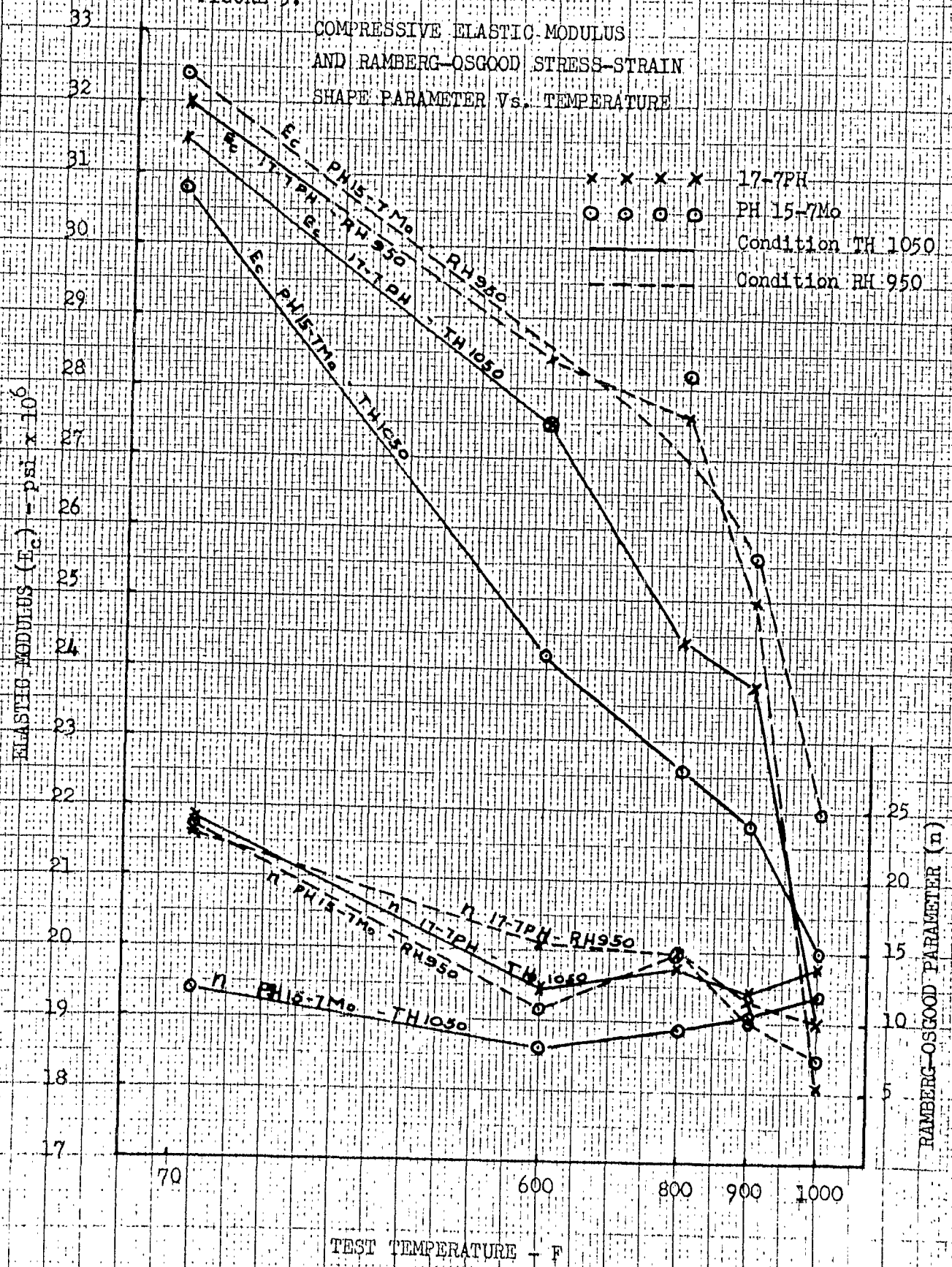


ENGINEER Boyd/McCarthy	NORTHROP AIRCRAFT INC. NORTHROP DIVISION	PAGE 14
CHECKER		REPORT NO. NAT-58-569
DATE 31 July 1958		MODEL

Rev. 23 October 1961

FIGURE 5:

COMPRESSIVE ELASTIC MODULUS
AND RAMBERG-OSGOOD STRESS-STRAIN
SHAPE PARAMETER Vs. TEMPERATURE



ENGINEER

Boyd/McCarthy

CHECKER

NORTHROP AIRCRAFT, INC.
NORTHROP DIVISION

PAGE

15

REPORT NO.

NAI-58-569

MODEL

DATE 31 July 1958

Rev. 23 October 1961

TABLE VI. TENSILE PROPERTIES OF 17-7PH AND PH 15-7Mo STEEL AFTER
THERMAL EXPOSURE CONDITION TH 1050 *

Exposure		17-7PH				PH 15-7Mo			
Temp	Time	Specimen	Fty ksi	Ftu ksi	Elong. % in 2 in.	Specimen	Fty ksi	Ftu ksi	Elong. % in 2 in.
700F	100 hr	1-1	197.3	205.6	6.0	4-1	206.4	215.7	6.0
		2-1	191.1	199.9	9.0	6-1	195.6	209.7	9.0
		3-1	200.3	209.4	8.0	8-1	205.8	218.1	6.5
		Avg	196.2	205.0	7.7	Avg	202.6	214.5	7.2
	500 hr	1-2	206.7	217.5	5.5	4-20	214.8	224.7	8.0
800F	100 hr	2-2	203.5	210.9	10.0	6-2	208.7	222.1	9.5
		3-2	209.5	217.2	8.5	8-2	211.1	226.0	7.5
		Avg	206.6	215.2	8.0	Avg	211.5	224.3	8.3
		1-3	212.3	222.1	5.5	4-3	224.5	229.8	5.0
	500 hr	2-3	208.4	218.7	8.0	6-3	217.2	227.7	6.0
900F	100 hr	3-3	213.1	223.0	6.5	8-3	214.7	228.3	7.0
		Avg	211.3	221.3	6.7	Avg	218.8	228.6	6.0
		1-4	232.0	239.0	3.5	4-4	240.6	248.3	4.0
		2-4	224.3	231.8	6.0	6-4	228.1	239.8	7.0
	500 hr	3-4	232.3	240.0	—	8-4	226.4	241.4	8.0
900F	100 hr	Avg	229.5	236.9	4.8	Avg	231.7	243.2	6.3
		1-5	210.3	220.0	5.0	4-5	217.5	225.1	5.0
		2-5	206.3	213.6	8.5	6-5	206.6	219.0	10.0
		3-5	210.7	221.7	7.5	8-5	204.7	219.8	8.5
	100 hr	Avg	209.1	218.4	7.0	Avg	209.6	221.3	7.8

*Tested at room temperature.

100 hour data are plotted on Figure 6

500 hour data are plotted on Figure 7

ENGINEER Boyd/McCarthy	NORTHROP AIRCRAFT, INC. NORTHROP DIVISION	PAGE -16
CHECKER		REPORT NO. NAI-58-569
DATE 31 July 1958 Rev. 23 October 1961		MODEL

TABLE VI. TENSILE PROPERTIES OF 17-7PH AND PH 15-7Mo STEEL AFTER
THERMAL EXPOSURE CONDITION TH 1050*
(Continued)

Exposure		17-7PH					PH 15-7Mo				
Temp	Time	Specimen	Fty ksi	Ftu ksi	Elong. % in 2 in.	Specimen	Fty ksi	Ftu ksi	Elong. % in 2 in.		
900F	500 hr	1-6	203.3	209.5	6.5	4-6	213.9	224.3	8.5		
		2-6	198.8	206.0	8.5	6-6	203.4	218.7	9.0		
		3-6	206.1	214.2	7.0	8-6	203.7	220.2	9.0		
		Avg	202.7	209.9	7.3	Avg	207.0	221.1	8.8		
Unexposed		Avg Table II	169.5	182.0	9.2	Avg Table III	176.8	188.0	9.4		

* Tested at room temperature.
100 hour data are plotted on Figure 6.
500 hour data are plotted on Figure 7.

ENGINEER Boyd/McCarthy	NORTHROP AIRCRAFT, INC. NORTHROP DIVISION	PAGE 17
CHECKER		REPORT NO. NAI-58-569
DATE 31 July 1958 Rev. 23 October 1961		MODEL

TABLE VII. TENSILE PROPERTIES OF 17-7PH AND PH 15-7Mo STEEL AFTER
THERMAL EXPOSURE CONDITION RH 950*

Exposure		17-7PH				PH 15-7Mo			
Temp	Time	Specimen	Fty ksi	Ftu ksi	Elong. % in 2 in.	Specimen	Fty ksi	Ftu ksi	Elong. % in 2 in.
700F	100 hr	1-36	226.7	240.4	5.0	4-36	223.6	247.7	5.5
		2-36	228.2	241.2	6.0	6-36	236.4	256.6	6.0
		3-36	230.3	247.0	4.0	8-36	237.6	255.3	5.5
		AVG	228.4	242.9	5.0	AVG	232.5	253.2	5.7
	500 hr	1-37	230.4	246.7	2.0	4-37	233.3	255.8	6.0
		2-37	232.4	249.1	5.5	6-37	243.9	263.6	4.5
		3-37	240.3	256.2	2.0	8-37	246.3	270.5	6.5
		AVG	234.4	250.7	3.2	AVG	241.2	263.3	5.7
800F	100 hr	1-38	238.5	254.3	2.5	4-38	233.3	257.1	6.0
		2-38	241.4	256.7	5.0	6-38	240.0	261.0	4.0
		3-38	241.9	255.0	1.0	8-38	244.5	266.1	6.0
		AVG	240.6	255.3	2.8	AVG	239.3	261.4	5.3
	500 hr	1-39	236.9	241.0	0.5	4-39	239.7	258.3	6.0
		2-39	240.4	240.4	0.5	6-39	251.0	266.5	2.0
		3-39	187.7	187.7	0	8-39	246.6	267.5	6.0
		AVG	221.7	223.0	0.3	AVG	245.8	264.1	4.7
900F	100 hr	1-41	228.5	239.3	3.0	4-41	232.9	251.2	5.0
		2-41	222.8	235.7	5.0	6-41	238.4	255.3	6.0
		3-41	233.8	242.8	1.5	8-41	235.1	256.5	6.0
		AVG	228.4	239.3	3.2	AVG	235.5	254.3	5.7

* Tested at room temperature.

100 hour data are plotted on Figure 6.

500 hour data are plotted on Figure 7.

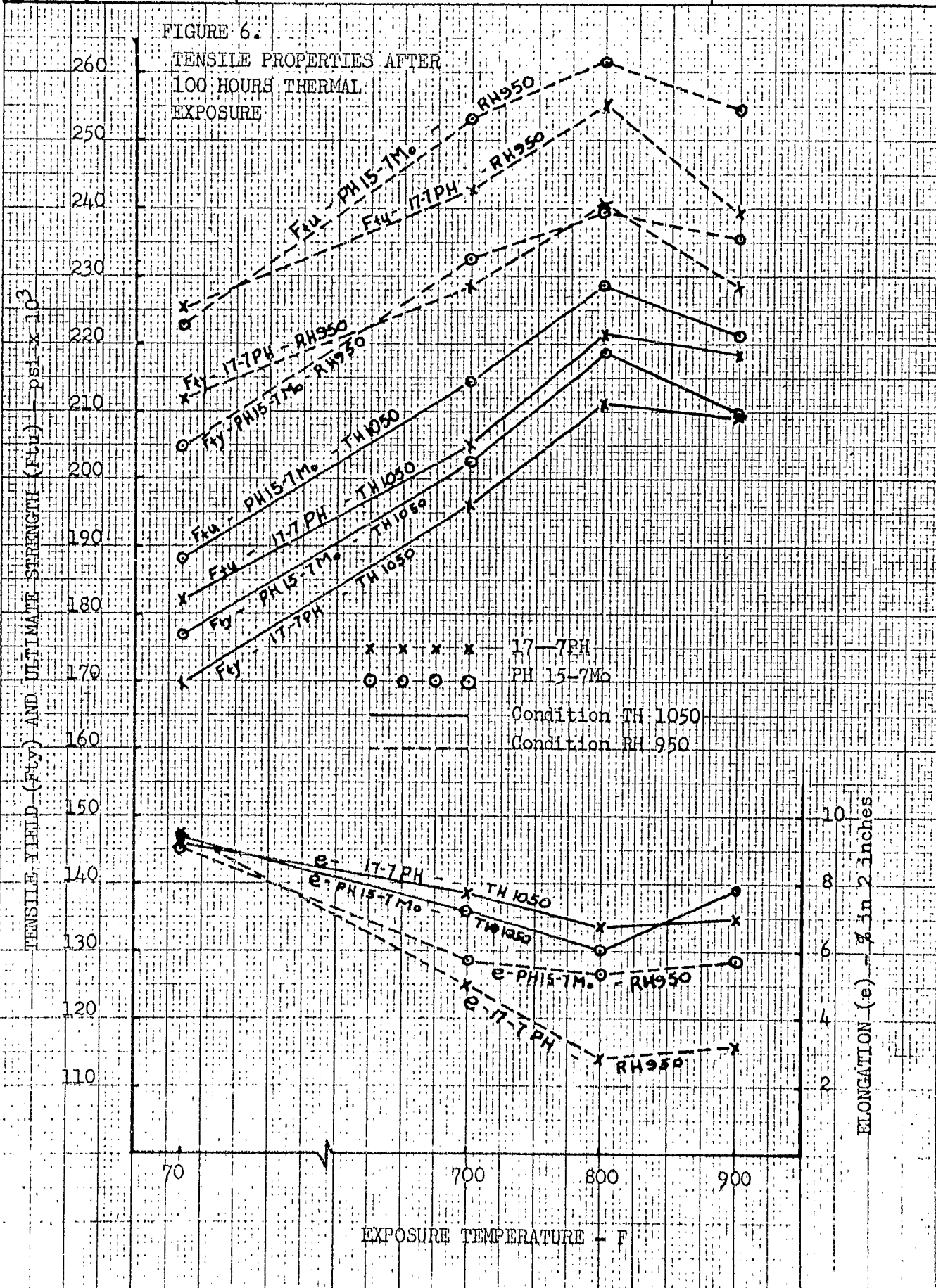
ENGINEER Boyd/McCarthy	NORTHROP AIRCRAFT, INC. NORTHROP DIVISION	PAGE 18
CHECKER		REPORT NO. NAI-58-569
DATE 31 July 1958		MODEL
Rev. 23 October 1961		

TABLE VII. TENSILE PROPERTIES OF 17-7PH AND PH 15-7Mo STEEL AFTER
THERMAL EXPOSURE CONDITION RH 950*

Exposure		17-7PH					PH 15-7Mo				
Temp	Time	Specimen	Fty ksi	Ftu ksi	Elong. % in 2 in.	Specimen	Fty ksi	Ftu ksi	Elong. % in 2 in.		
900F	500 hr	1-42	214.7	221.6	7.0	4-42	227.5	244.8	5.5		
		2-42	211.4	218.7	6.8	6-42	233.3	244.6	6.0		
		3-42	223.5	234.5	5.5	8-42	236.9	253.8	6.0		
		Avg	216.5	224.9	6.4	Avg	232.6	247.7	5.8		
Unexposed		Avg Table II	212.1	225.3	9.5	Avg Table III	204.7	223.0	9.0		

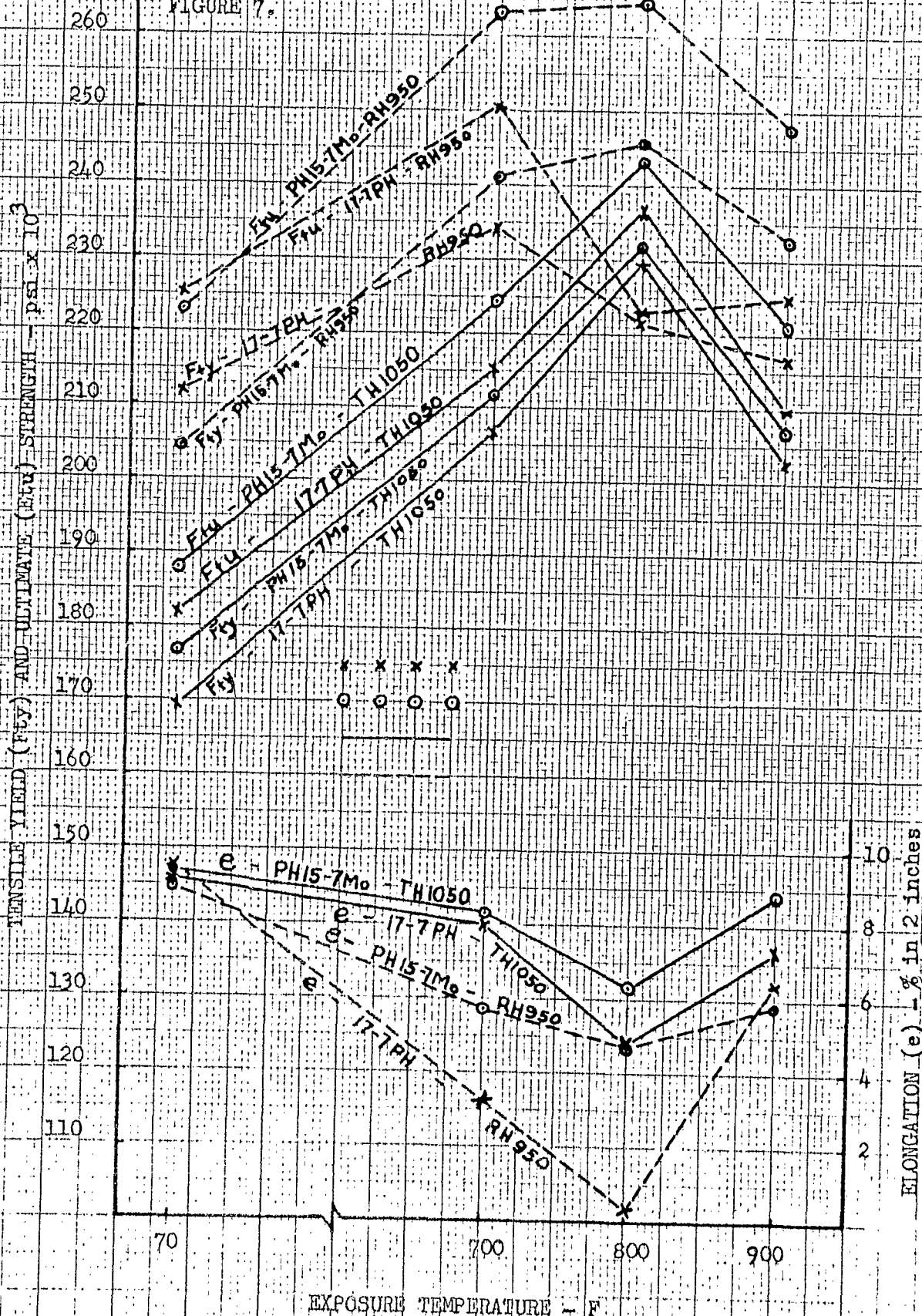
* Tested at room temperature.
500 hour data are plotted on Figure 7.

ENGINEER Boyd/McCarthy	NORTHROP AIRCRAFT INC. NORTHROP DIVISION	PAGE 19
CHECKER		REPORT NO. NAT-58-569
DATE 31 July 1958		MODEL



ENGINEER Boyd/McCarthy	NORTHROP AIRCRAFT INC. NORTHROP DIVISION	PAGE 20
CHECKER		REPORT NO. NAI-58-569
DATE 31 July 1958		MODEL

TENSILE PROPERTIES AFTER 500 HOURS THERMAL EXPOSURE
FIGURE 7.



ENGINEER
Boyd/McCarthy
CHECKERNORTHROP AIRCRAFT, INC.
NORTHROP DIVISION

PAGE

21

REPORT NO.

NAI-58-569

MODEL

DATE

31 July 1958

TABLE VIII. TENSILE PROPERTIES OF 17-7PH STEEL
SHEET No. 1, HEAT No. 57391

Test Temp	Condition TH 1050						Condition RH 950					
	Specimen	Fty ksi	Ftu ksi	Elong. % in 2 in.	E psi x 10 ⁶	Specimen	Fty ksi	Ftu ksi	Elong. % in 2 in.	E psi x 10 ⁶		
Room	1-17	170.7	182.1	7.5	26.0	1-55	213.1	224.8	8.5	27.8		
	1-18	170.7	182.6	8.0	26.2	1-56	213.1	224.8	9.5	28.2		
	1-19	171.4	182.6	8.0	26.1	1-57	212.6	224.8	7.0	27.2		
	Avg	170.9	182.4	7.8	26.1	Avg	212.9	224.8	8.3	27.7		
600F	1-7	162.5	171.8	5.0	25.2	1-35	172.2	187.2	7.5	24.5		
	1-8	159.5	170.4	3.8	26.3	1-43	173.4	188.1	7.5	26.6		
	1-9	162.1	172.2	4.0	26.1	1-44	170.4	189.1	6.5	28.0		
	Avg	161.4	171.5	4.3	25.9	Avg	172.0	188.1	7.2	26.4		
800F	1-10	142.1	150.8	10.0	22.3	1-45	140.7	161.5	18.0	24.6		
	1-11	139.1	149.5	10.0	24.9	1-47	140.1	165.3	14.0	27.4		
	1-12	138.6	150.3	9.5	26.5	1-48	144.3	167.0	15.5	24.4		
	Avg	139.9	150.2	9.8	24.6	Avg	141.7	164.6	15.8	25.5		
900F	1-13	114.4	127.5	17.5	24.8	1-49	119.3	144.3	14.5	24.5		
	1-14	117.8	130.0	17.0	23.8	1-50	121.3	143.6	18.0	22.8		
	1-15	116.5	129.6	15.5	23.6	1-51	122.5	143.9	17.0	22.3		
	Avg	116.2	129.0	16.7	24.1	Avg	121.0	143.9	16.5	23.2		
1000F	1-31	84.2	100.8	35.0	20.7	1-52	77.8	98.4	27.0	20.0		
	1-32	82.3	98.3	34.0	21.1	1-53	80.8	101.1	31.0	21.7		
	1-33	81.9	98.4	26.0	19.6	1-54	80.5	101.6	31.5	22.2		
	Avg	82.8	99.2	31.7	20.5	Avg	79.7	100.4	29.8	21.3		

ENGINEER

Boyd/McCarthy

CHECKER

NORTHROP AIRCRAFT, INC.
NORTHROP DIVISION

PAGE

22

REPORT NO.

NAI-58-569

DATE

31 July 1958

MODEL

TABLE IX. TENSILE PROPERTIES OF 17-7PH STEEL
SHEET No. 2, HEAT No. 66922

Test Temp	Condition TH 1050						Condition RH 950			
	Specimen	Fty ksi	Ftu ksi	Elong. % in 2 in.	E psi x 10 ⁶	Specimen	Fty ksi	Ftu ksi	Elong. % in 2 in.	E psi x 10 ⁶
Room	2-18	165.7	177.8	10.5	25.7	2-55	208.8	221.2	11.0	27.6
	2-19	165.5	177.3	11.0	25.5	2-56	209.7	223.6	10.5	27.7
	2-20	164.1	178.2	10.5	27.3	2-57	212.7	223.7	9.5	26.2
	Avg	165.1	177.8	10.7	26.2	Avg	210.4	222.8	10.3	27.2
600F	2-7	155.4	165.9	5.5	25.3	2-35	174.8	191.2	5.5	26.7
	2-8	156.8	166.0	5.0	25.0	2-43	174.6	191.3	4.5	26.0
	2-9	153.7	163.4	5.0	24.3	2-44	177.0	191.3	4.5	25.6
	Avg	155.3	165.1	5.2	24.9	Avg	175.5	191.3	4.8	26.1
800F	2-10	133.8	144.2	11.0	22.0	2-45	143.6	167.1	12.5	22.3
	2-11	133.1	145.4	12.0	23.4	2-46	144.5	165.7	12.5	22.2
	2-12	135.0	146.4	13.0	24.1	2-47	146.4	170.9	12.5	22.7
	Avg	134.0	145.3	12.0	23.2	Avg	144.8	167.9	12.5	22.4
900F	2-13	112.9	126.0	15.0	24.8	2-48	122.1	142.4	16.0	21.4
	2-14	112.6	125.7	17.0	24.4	2-49	122.6	143.8	11.5	22.1
	2-15	112.8	125.5	16.5	22.5	2-50	122.1	143.6	16.0	22.9
	Avg	112.8	125.7	16.2	23.9	Avg	122.3	143.3	14.5	22.1
1000F	2-32	79.6	96.2	29.5	20.3	2-51	76.5	99.4	26.0	21.2
	2-33	76.6	97.1	30.5	20.0	2-52	73.5	100.1	21.0	26.9
	2-34	79.7	95.7	29.5	21.6	2-54	75.3	98.9	35.5	20.8
	Avg	78.6	96.3	29.8	20.6	Avg	75.1	99.5	27.5	23.0

ENGINEER

Boyd/McCarthy
CHECKER

DATE

31 July 1958

NORTHROP AIRCRAFT, INC.
NORTHROP DIVISION

PAGE

23

REPORT NO.

NAI-58-569

MODEL

TABLE X. TENSILE PROPERTIES OF 17-7PH STEEL
SHEET No. 3, HEAT No. 66880

Test Temp	Condition TH 1050						Condition RH 950					
	Specimen	Fty ksi	Ftu ksi	Elong. % in 2 in.	E psi x 10 ⁶	Specimen	Fty ksi	Ftu ksi	Elong. % in 2 in.	E psi x 10 ⁶		
Room	3-19	171.7	185.0	9.0	26.4	3-56	211.8	227.9	8.5	28.2		
	3-20	172.9	185.4	9.0	26.0	3-57	214.0	227.9	11.0	28.0		
	3-21	173.0	186.7	9.5	25.9	3-58	213.6	228.8	10.0	26.8		
	Avg	172.5	185.7	9.2	26.1	Avg	213.1	228.2	9.8	27.7		
600F	3-7	164.2	173.8	5.0	24.9	3-43	180.7	196.7	6.0	26.4		
	3-8	165.5	174.6	5.0	25.9	3-44	178.2	194.3	5.5	28.4		
	3-9	164.6	173.5	4.0	23.7	3-45	174.0	192.7	7.5	27.8		
	Avg	164.8	174.0	4.7	24.8	Avg	177.6	194.6	6.3	27.5		
800F	3-10	141.1	153.1	13.5	25.8	3-46	147.4	167.6	14.0	22.6		
	3-11	140.8	153.5	13.5	24.0	3-47	148.2	166.7	15.0	22.4		
	3-12	142.0	153.8	11.0	24.5	3-49	148.4	164.2	10.3	24.8		
	Avg	141.3	153.5	12.7	24.8	Avg	148.0	166.2	13.1	23.3		
900F	3-14	115.4	128.4	19.0	22.1	3-50	125.1	144.1	17.0	22.0		
	3-15	113.4	128.2	15.5	22.2	3-51	125.1	143.6	12.5	21.2		
	3-16	113.9	128.9	21.0	23.1	3-52	125.5	143.3	15.0	21.2		
	Avg	114.2	128.5	18.5	22.5	Avg	125.2	143.7	14.8	21.5		
1000F	3-32	79.2	97.3	28.0	20.6	3-53	74.2	97.0	29.0	23.2		
	3-33	80.8	96.4	26.0	19.1	3-54	76.2	99.0	32.5	20.3		
	3-34	81.7	97.8	39.5	19.1	3-55	76.7	96.1	32.5	18.8		
	Avg	80.6	97.2	31.2	19.6	Avg	75.7	97.4	31.3	20.8		

ENGINEER Boyd/McCarthy		NORTHROP AIRCRAFT, INC. NORTHROP DIVISION					PAGE 24	
CHECKER							REPORT NO. NAI-58-569	
DATE 31 July 1958							MODEL	

TABLE XI. TENSILE PROPERTIES OF PH 15-7Mo STEEL SHEET No. 4, HEAT No. 57814											
		Condition TH 1050					Condition RH 950				
Test Temp	Specimen	Fty ksi	Ftu ksi	Elong. % in 2 in.	E psi x 10 ⁶	Specimen	Fty ksi	Ftu ksi	Elong. % in 2 in.	E psi x 10 ⁶	
Room	4-10	180.0	185.8	7.5	25.7	4-43	203.0	218.2	9.0	26.9	
	4-14	181.8	184.0	8.0	26.0	4-57	198.0	218.3	9.5	26.8	
	4-19	178.6	185.1	8.0	25.7	4-58	198.5	217.1	8.0	25.6	
	AVG	180.1	185.0	7.8	25.8	AVG	199.8	217.9	8.8	26.4	
600F	4-7	165.6	177.8	3.8	26.5	4-44	169.4	199.0	4.0	28.5	
	4-11	166.3	176.3	3.5	25.7	4-45	171.8	197.0	4.0	26.8	
	4-12	164.6	178.0	5.0	26.4	4-47	169.9	199.4	6.0	27.3	
	AVG	165.5	177.4	4.1	26.2	AVG	170.4	198.5	4.7	27.5	
800F	4-16	147.9	161.8	9.5	25.3	4-48	148.6	177.4	8.5	24.1	
	4-17	149.8	162.8	10.5	26.2	4-49	147.1	177.4	10.5	24.9	
	4-18	147.1	160.8	9.8	24.5	4-51	147.4	179.2	9.5	26.0	
	AVG	148.3	161.8	9.9	25.3	AVG	147.7	178.0	9.5	25.0	
900F	4-13	125.1	141.6	15.0	24.1	4-52	128.6	160.1	11.0	22.0	
	4-21	126.0	138.3	14.5	24.9	4-53	127.9	160.3	12.0	22.6	
	4-31	128.5	144.3	16.0	23.9	4-54	125.7	159.8	11.5	24.3	
	AVG	126.5	141.4	15.2	24.3	AVG	127.4	160.1	11.5	23.0	
1000F	4-32	97.3	115.0	18.0	21.9	4-59	99.2	130.0	14.0	21.9	
	4-33	98.2	114.2	20.0	21.1	4-60	98.7	129.5	15.0	22.1	
	4-34	98.5	114.7	19.0	22.0	4-61	98.3	132.6	16.5	22.1	
	AVG	98.0	114.6	19.0	21.7	AVG	98.7	130.7	15.2	22.0	

ENGINEER Boyd/McCarthy		NORTHROP AIRCRAFT, INC. NORTHROP DIVISION					PAGE 25	
CHECKER							REPORT NO. NAI-58-569	
DATE 31 July 1958							MODEL	

TABLE XII. TENSILE PROPERTIES OF PH 15-7Mo STEEL SHEET No. 6, HEAT No. 57896										
Condition TH 1050						Condition RH 950				
Test Temp	Specimen	Fty ksi	Ftu ksi	Elong. % in 2 in	E psi x 10 ⁶	Specimen	Fty ksi	Ftu ksi	Elong. % in 2 in	E psi x 10 ⁶
Room	6-19	175.0	186.2	10.0	24.6	6-56	207.0	225.1	10.0	25.6
	6-20	176.4	187.7	10.0	25.2	6-54	205.5	223.6	9.0	26.3
	6-21	175.7	188.1	10.0	25.3	6-58	204.5	221.1	8.5	26.2
	Avg	175.7	187.3	10.0	25.0	Avg	205.7	223.3	9.2	26.0
600F	6-7	162.1	175.0	3.8	25.0	6-35	177.7	204.4	5.0	27.8
	6-8	161.4	174.7	3.5	25.6	6-43	180.8	205.0	6.0	26.5
	6-9	161.7	175.8	5.0	27.6	6-44	176.3	205.6	5.0	28.5
	Avg	161.7	175.2	4.1	26.1	Avg	178.3	205.0	5.3	27.6
800F	6-10	142.9	158.5	8.0	25.3	6-45	152.0	182.1	11.5	25.0
	6-11	142.9	158.6	8.0	24.0	6-46	152.5	182.1	11.5	24.7
	6-12	141.6	157.5	10.5	23.6	6-47	152.5	180.8	10.8	24.4
	Avg	142.5	158.2	8.8	24.3	Avg	152.3	181.7	11.3	24.7
900F	6-13	124.8	141.8	13.5	24.7	6-48	129.4	160.3	14.5	23.8
	6-14	127.4	143.8	10.0	26.2	6-49	130.6	164.6	10.0	23.7
	6-15	123.1	142.3	12.5	27.1	6-50	128.3	161.1	11.5	23.9
	Avg	125.1	142.6	12.0	26.0	Avg	129.4	162.0	12.0	23.8
1000F	6-32	95.6	113.6	18.0	22.5	6-51	100.0	130.0	13.0	21.0
	6-33	96.9	113.8	19.5	21.5	6-53	99.0	130.2	16.0	20.1
	6-34	97.8	114.6	20.0	22.4	6-55	99.8	130.6	16.5	20.8
	Avg	96.8	114.0	19.2	22.1	Avg	99.6	130.3	15.2	20.6

ENGINEER		NORTHROP AIRCRAFT, INC. NORTHROP DIVISION						PAGE
Boyd/McCarthy								26
CHECKER								REPORT NO.
								NAI-58-569
DATE 31 July 1958								MODEL
Rev. 23 October 1961								

TABLE XIII. TENSILE PROPERTIES OF PH 15-7Mo STEEL SHEET No. 8, HEAT No. 57798											
		Condition TH 1050					Condition RH 950				
Test Temp	Specimen	Fty ksi	Ftu ksi	Elong. % in 2 in.	E psi x 10 ⁶	Specimen	Fty ksi	Ftu ksi	Elong. % in 2 in.	E psi x 10 ⁶	
Room	8-12	173.0	191.2	10.5	26.4	8-55	210.6	229.1	9.0	25.8	
	8-13	174.8	191.5	10.0	26.3	8-58	208.6	228.1	9.0	25.7	
	8-17	176.3	192.2	11.0	25.9	8-61	206.6	226.1	9.0	25.0	
	Avg	174.7	191.6	10.5	26.2	Avg	208.6	227.8	9.0	25.5	
600F	8-7	161.8	178.1	4.5	25.0	8-35	185.5	212.0	5.0	27.2	
	8-8	165.1	182.3	5.0	26.2	8-43	180.0	207.6	4.0	28.2	
	8-9	163.9	181.3	5.0	27.6	8-44	176.5	210.7	5.2	27.2	
	Avg	163.6	180.6	4.8	26.3	Avg	180.7	210.1	4.7	27.5	
800F	8-15	148.5	164.9	10.0	22.8	8-45	152.7	186.0	10.0	25.9	
	8-16	144.5	162.3	10.5	22.4	8-46	150.8	184.1	7.5	25.9	
	8-18	142.3	161.9	9.0	24.0	8-47	148.0	184.8	9.0	25.9	
	Avg	145.1	164.0	9.8	23.7	Avg	150.5	185.0	8.8	25.9	
900F	8-19	126.4	146.2	12.0	23.7	4-48	132.1	167.0	8.0	23.0	
	8-20	127.3	145.0	12.0	24.0	8-49	133.1	169.0	12.0	24.1	
	8-21	125.4	145.7	12.0	23.5	8-50	131.9	168.5	12.0	23.1	
	Avg	126.4	145.6	12.0	23.7	Avg	132.4	168.2	10.7	23.4	
1000F	8-32	97.1	120.2	20.0	22.6	8-53	102.9	136.9	13.5	23.4	
	8-33	98.8	120.2	19.5	22.6	8-56	104.8	137.1	13.0	22.0	
	8-34	99.0	119.8	17.5	22.4	8-57	104.8	136.6	12.8	23.3	
	Avg	98.3	120.1	19.0	22.5	Avg	104.2	136.9	13.1	22.9	

ENGINEER Boyd/McCarthy		NORTHROP AIRCRAFT, INC. NORTHROP DIVISION				PAGE 27	
CHECKER						REPORT NO. NAI-58-569	
DATE 31 July 1958						MODEL	

TABLE XIV. COMPRESSION PROPERTIES OF 17-7PH STEEL SHEET No. 1, HEAT No. 57391								
Test Temp	Condition TH 1050				Condition RH 950			
	Specimen	Fcy ksi	E psi x 10 ⁶	'n'	Specimen	Fcy ksi	E psi x 10 ⁶	'n'
Room	1K1	203.4	30.6	22.6	1K18	233.0	32.9	29.2
	1K2	197.8	31.1	28.3	1K33	240.3	31.0	33.1
	1K3	194.6	32.3	28.3	1K20	237.8	31.4	22.6
	Avg	198.6	31.3	26.1	Avg	237.0	31.8	24.8
600F	1K4	169.3	26.3	18.2	1K21	185.1	29.2	14.5
	1K5	165.5	26.4	15.1	1K22	191.0	28.9	14.9
	1K6	164.7	26.3	11.5	1K23	176.4	29.2	—
	Avg	166.5	26.3	14.3	Avg	184.2	29.1	14.7
800F	1K7	140.2	24.6	13.1	1K24	159.7	25.7	15.4
	1K8	137.8	23.2	13.3	1K25	161.7	27.4	13.6
	1K9	133.3	24.1	9.0	1K26	162.9	27.9	10.0
	Avg	137.1	24.0	11.3	Avg	161.4	27.0	12.5
900F	—	—	—	—	1K27	138.1	23.8	16.0
	1K11	115.0	26.4	12.5	1K28	140.8	25.7	19.5
	1K12	113.1	22.3	13.0	1K29	129.0	25.0	6.3
	Avg	114.1	24.4	12.7	Avg	135.9	24.8	10.6
1000F	1K13	92.6	17.2	11.9	1K30	87.7	18.8	9.0
	1K14	98.9	21.4	19.5	1K31	80.7	18.5	6.5
	1K15	95.1	18.4	18.2	1K32	87.3	16.8	10.7
	Avg	95.5	19.0	15.8	Avg	85.2	18.0	8.3

DATE _____

31 July 1958

TABLE XV. COMPRESSION PROPERTIES OF 17-7PH STEEL
SHEET No. 2, HEAT No. 66922

Test Temp	Condition TH 1050				Condition RH 950			
	Specimen	Fcy ksi	E psi x 10 ⁶	'n'	Specimen	Fcy ksi	E psi x 10 ⁶	'n'
Room	2K1	198.7	31.5	26.8	2K18	243.5	31.6	39.0
	2K2	197.4	33.0	27.5	2K19	236.9	33.4	33.1
	2K16	206.3	29.0	25.4	2K20	237.9	33.9	23.6
	Avg	200.8	31.2	26.8	Avg	239.4	33.0	31.0
600F	2K4	167.9	27.3	18.8	2K21	189.9	27.4	36.9
	2K5	164.7	26.6	9.2	2K22	184.7	27.4	28.3
	2K6	166.5	25.8	14.7	2K23	174.0	27.9	—
	Avg	166.4	26.5	12.8	Avg	182.9	27.5	32.0
800F	2K7	140.4	24.2	17.0	2K24	168.8	30.4	11.6
	2K8	138.7	24.1	12.5	2K25	167.2	25.6	13.9
	2K9	143.7	24.7	13.1	2K26	166.0	28.2	13.3
	Avg	140.9	24.4	13.9	Avg	167.3	28.1	13.0
900F	2K10	110.5	21.3	15.5	2K27	133.7	24.7	7.8
	2K11	114.9	22.6	18.5	2K28	136.7	24.9	11.9
	2K12	115.7	23.2	19.5	2K29	137.8	24.0	13.6
	Avg	113.7	22.4	17.6	Avg	136.1	24.5	10.4
1000F	2K13	90.1	18.1	19.5	2K30	88.9	17.3	10.1
	2K14	94.0	18.6	10.1	2K31	91.7	19.2	13.8
	2K15	95.8	18.9	11.2	2K32	85.2	21.2	10.1
	Avg	93.3	18.5	12.4	Avg	88.6	19.2	11.1

ENGINEER Boyd/McCarthy		NORTHROP AIRCRAFT, INC. NORTHROP DIVISION				PAGE 29		
CHECKER						REPORT NO. NAT-58-569		
DATE 31 July 1958						MODEL		
TABLE XVI. COMPRESSION PROPERTIES OF 17-7PH STEEL SHEET No. 3, HEAT No. 66880								
Test Temp	Condition TH 1050				Condition RH 950			
	Specimen	Fcy ksi	E psi x 10 ⁶	'n'	Specimen	Fcy ksi	E psi x 10 ⁶	'n'
Room	3K1	206.0	32.8	22.6	3K33	239.5	31.8	16.2
	3K2	205.1	32.8	20.7	3K34	246.6	30.3	18.2
	3K3	206.4	30.1	18.2	3K35	247.6	32.0	17.9
	Avg	205.8	31.9	20.3	Avg	244.5	31.3	17.5
600F	3K4	167.5	29.3	9.2	3K21	187.9	28.1	11.1
	3K5	172.9	31.2	9.1	3K22	182.5	28.6	10.6
	3K6	172.7	28.4	14.3	3K23	195.3	29.3	10.9
	Avg	171.0	29.7	10.3	Avg	188.6	28.7	10.9
800F	3K7	145.5	25.9	13.6	3K24	167.6	27.9	32.0
	3K8	147.5	24.3	22.6	3K25	169.9	28.3	16.7
	3K9	147.3	24.2	21.2	3K26	168.4	26.9	26.1
	Avg	146.8	24.8	18.2	Avg	168.6	27.7	23.1
900F	3K10	107.8	19.1	9.2	3K27	139.2	25.2	14.1
	3K11	108.0	29.9	9.0	3K28	141.1	25.9	22.6
	3K12	115.7	23.9	9.1	3K29	138.5	26.0	11.6
	Avg	110.5	24.6	9.1	Avg	139.6	25.7	14.9
1000F	3K13	101.0	20.3	13.6	3K30	89.8	20.7	14.7
	3K14	97.4	17.7	14.1	3K31	83.0	14.1	10.1
	3K15	99.2	20.8	14.9	3K32	87.1	16.3	9.7
	Avg	99.2	19.6	14.1	Avg	86.3	17.0	11.1

ENGINEER Boyd/McCarthy		NORTHROP AIRCRAFT, INC. NORTHROP DIVISION				PAGE 30		
CHECKER						REPORT NO. NAI-58-569		
DATE 31 July 1958						MODEL		
TABLE XVII. COMPRESSION PROPERTIES OF PH 15-7Mo STEEL SHEET No. 4, HEAT No. 57814								
Test Temp	Condition TH 1050				Condition RH 950			
	Specimen	Fcy ksi	E psi x 10 ⁶	"n"	Specimen	Fcy ksi	E psi x 10 ⁶	"n"
Room	4K1	199.8	32.3	17.0	4K18	237.6	32.0	23.6
	4K2	199.0	31.6	22.6	4K19	238.6	31.8	30.1
	4K16	205.1	28.9	23.1	4K20	236.9	32.2	24.8
	Avg	201.3	30.9	20.3	Avg	237.7	32.0	26.1
600F	4K4	172.5	27.1	9.2	4K21	192.9	29.4	8.7
	4K5	170.8	26.3	11.6	4K22	192.4	26.7	10.5
	4K6	172.1	28.2	7.5	4K23	192.5	27.6	10.5
	Avg	171.8	27.2	9.0	Avg	192.6	27.9	10.1
800F	4K7	146.9	22.6	13.8	4K24	171.7	29.0	10.8
	4K8	148.9	19.7	28.3	4K25	171.5	28.1	17.0
	4K9	148.8	26.0	9.9	4K26	164.8	28.0	14.7
	Avg	148.2	22.8	14.1	Avg	169.3	28.4	13.6
900F	4K10	126.4	25.6	10.9	4K27	148.2	24.2	10.4
	4K11	127.6	25.4	9.2	4K28	144.1	25.3	14.3
	4K12	121.7	21.1	12.1	4K29	139.5	25.0	8.4
	Avg	125.2	24.0	10.6	Avg	143.9	24.8	10.4
1000F	4K13	105.3	20.0	14.1	4K30	121.7	24.6	6.8
	4K14	113.6	22.1	13.0	4K31	117.1	20.5	7.8
	4K15	109.0	20.3	14.0	4K32	109.9	19.6	8.2
	Avg	109.3	20.8	13.9	Avg	116.2	21.6	7.6

ENGINEER		NORTHROP AIRCRAFT, INC. NORTHROP DIVISION				PAGE		
Boyd/McCarthy						31		
CHECKER						REPORT NO.		
						NAI-58-569		
DATE						MODEL		
31 July 1958								
TABLE XVIII. COMPRESSION PROPERTIES OF PH 15-7Mo STEEL SHEET No. 6, HEAT No. 57896								
		Condition TH 1050				Condition RH 950		
Test Temp	Specimen	Fcy ksi	E psi x 10 ⁶	n'	Specimen	Fcy ksi	E psi x 10 ⁶	n'
Room	6K1	189.7	32.3	34.3	6K18	236.3	33.2	33.1
	6K2	174.1	31.9	10.7	6K19	240.55	35.0	16.7
	6K3	172.5	32.1	14.9	6K20	240.3	33.1	29.2
	Avg	178.8	32.1	15.5	Avg	239.1	33.8	24.2
600F	6K4	161.2	24.1	10.5	6K21	195.3	27.2	10.4
	6K5	165.7	23.1	18.5	6K22	196.3	27.2	11.5
	6K6	144.8	22.8	10.8	6K23	196.7	28.0	13.3
	Avg	157.2	23.3	12.3	Avg	196.1	27.5	11.6
800F	6K7	138.1	23.3	11.0	6K24	162.7	28.2	30.1
	6K8	144.5	23.4	15.1	6K25	175.9	27.3	13.4
	6K9	139.6	22.7	13.3	6K26	174.1	27.2	17.5
	Avg	140.7	23.2	12.8	Avg	170.9	27.6	17.6
900F	6K10	130.0	20.7	18.5	6K27	148.0	28.0	13.3
	6K11	121.4	22.0	9.9	6K28	147.5	26.2	11.8
	6K12	120.3	20.9	12.5	6K29	151.2	24.1	12.7
	Avg	123.9	21.2	12.7	Avg	148.9	26.1	12.5
1000F	6K13	110.4	20.1	13.6	6K30	108.85	20.0	8.6
	6K14	107.1	20.7	12.8	6K32	117.3	22.1	8.8
	6K15	107.7	19.9	7.7	6K33	114.1	22.2	5.3
	Avg	108.4	20.2	10.6	Avg	113.4	21.4	7.0

ENGINEER Boyd/McCarthy	NORTHROP AIRCRAFT, INC. NORTHROP DIVISION	PAGE 32
CHECKER		REPORT NO. NAI-58-569
DATE 31 July 1958		MODEL

TABLE XIX. COMPRESSION PROPERTIES OF PH 15-7Mo STEEL
SHEET No. 8, HEAT No. 57798

Test Temp	Condition TH 1050				Condition RH 950			
	Specimen	F _{cy} ksi	E psi x 10 ⁶	"n"	Specimen	F _{cy} ksi	E psi x 10 ⁶	"n"
Room	8K1	145.4	28.6	7.9	8K18	251.1	31.0	28.3
	8K2	141.8	29.4	7.2	8K19	245.4	31.7	15.8
	8K3	143.4	30.0	7.7	8K20	252.3	31.3	27.5
	Avg	143.5	29.3	7.6	Avg	249.6	31.3	22.1
600F	8K4	122.7	22.3	5.8	8K21	204.1	26.4	11.5
	8K5	126.2	23.4	5.2	8K22	198.8	27.4	12.4
	8K6	127.2	20.1	6.4	8K23	197.7	27.8	9.2
	Avg	125.4	21.9	5.7	Avg	200.2	27.2	10.9
800F	8K7	121.8	21.8	5.8	8K27	180.1	31.7	9.9
	8K8	125.1	21.7	6.6	8K25	180.1	27.9	15.5
	8K9	123.2	22.4	6.1	8K26	182.7	26.2	24.2
	Avg	123.4	22.0	6.1	Avg	180.9	28.6	14.3
900F	8K10	119.15	19.1	11.9	8K27	149.7	26.7	9.4
	8K11	110.7	20.4	7.5	8K28	138.1	24.7	12.3
	8K12	114.2	22.0	8.4	8K29	129.6	25.9	5.8
	Avg	114.7	20.5	8.9	Avg	139.1	25.7	8.2
1000F	8K13	103.2	16.6	12.7	8K30	118.5	23.7	6.8
	8K14	101.6	18.9	10.2	8K31	119.9	22.7	8.1
	8K15	106.5	21.2	11.6	8K32	123.4	22.7	7.7
	Avg	103.8	18.9	11.4	Avg	120.6	23.0	7.5